Towards Soft X-ray Photon Correlation Spectroscopy of Critical Fluctuations

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The use of coherent soft X-rays for resonant magnetic scattering provides numerous possibilities for the study of *magnetic* nanostructures. For instance, static and slowly varying magnetic domains can be imaged, in particular, by holography in combination with resonant scattering [1]. In this way the reversal behavior in applied magnetic fields of extended and nanostructured magnetic objects has been investigated [2,3].
However, measuring the *dynamics* of magnetic samples remains an elusive and challenging task. Combining soft X-rays with the method of photon correlation spectroscopy (sXPCS) opens the opportunity of measuring such dynamics. While the photon correlation technique is routinely employed using visible light or hard X-rays, only few pioneering experiments have been carried out with soft-X-rays [4], and so far never in order to study magnetic fluctuations.
In the case of magnetic systems, the fluctuating units are regions with locally correlated magnetization, so-called spin blocks. By exploiting the x-ray magnetic dichroism as a unique contrast mechanism, sXPCS studies promise to be the first direct probe of spin blocks, without having to resort to macroscopic properties, such as magnetic susceptibility. The measurement of scaling law exponents close to magnetic phase transitions will be of fundamental interest.
Here we present first results of sXPCS experiments towards this goal that were performed at the BESSY II synchrotron source in Berlin, Germany. For pilot studies, we produced single perpendicular anisotropy layers with a Curie temperature slightly above room temperature and sample systems with size controlled magnetic entities to investigate critical magnetic fluctuations and the transition to a superparamagnetic state. Here, we report on recent progress of this project.

[1] Eisebitt et al., Nature **432**, 885 (2004).
[2] O. Hellwig et al., Journal of Applied Physics **99**, 08H307 (2006).
[3] (see contribution of C. Günther)
[4] A. C. Price et al., Physical Review Letters **82**, 755 (1999).